TTS-GAN: A Transformer-based Time-Series Generative Adversarial Network

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Abstract

Signal measurements appearing in the form of time series are one of the most common types of data used in medical machine learning applications. However, such datasets are often small, making the training of deep neural network architectures ineffective. For time-series, the suite of data augmentation tricks we can use to expand the size of the dataset is limited by the need to maintain the basic properties of the signal. Data generated by a Generative Adversarial Network (GAN) can be utilized as another data augmentation tool. RNN-based GANs suffer from the fact that they cannot effectively model long sequences of data points with irregular temporal relations. To tackle these problems, we introduce TTS-GAN, a transformer-based GAN which can successfully generate realistic synthetic time-series data sequences of arbitrary length, similar to the real ones. Both the generator and discriminator networks of the GAN model are built using a pure transformer encoder architecture. We use visualizations and dimensionality reduction techniques to demonstrate the similarity of real and generated time-series data. We also compare the quality of our generated data with the best existing alternative, which is an RNN-based time-series GAN.